



PID Network Interface Module for Reliance™ Shark PLC

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TABLE OF CONTENTS

PREFACE	vi
ABOUT THE PROGRAMMING EXAMPLES	vi
COPYRIGHT NOTICE	vi
TRADEMARK ACKNOWLEDGMENTS	vi

CHAPTER 1:INTRODUCTION

1.1	Manual Convention	Page 1-1
1.2	What You Have	Page 1-1
1.3	What Else You Need	Page 1-1
1.4	System Features	Page 1-2
1.5	Hardware Description	Page 1-2

CHAPTER 2:INSTALLATION

2.1	Module Placement	Page 2-1
2.2	Terminal Wiring	Page 2-1

CHAPTER 3:THE RECIPE EDITOR SOFTWARE

3.1	What is a "Recipe"?	Page 3-1
3.2	What is a "Job"?	Page 3-2
3.3	PID Parameter Information Flow	Page 3-2
3.4	Starting the Recipe Editor Software	Page 3-4
3.5	The Status Bar	Page 3-4
3.6	Accessing Commands Using the Pull-Down Menus	Page 3-4
3.6.1	The File Menu	Page 3-4
3.6.2	The Recipe Menu	Page 3-5
3.6.3	The Job Number Menu	Page 3-6
3.6.4	The Change Menu	Page 3-6

CHAPTER 4:AUTOMATIC MODE

4.1	Commands Initiated by the PLC	Page 4-1
4.2	NIM I/O Reference Usage	Page 4-1

4.3	NIM I/O Reference Definitions	.	.	.	.	Page 4-1
4.4	Executing PLC Commands.	.	.	.	.	Page 4-3
	RECIPE DOWNLOAD	.	.	.	.	Page 4-4
	JOB DOWNLOAD	.	.	.	.	Page 4-5
	MONITOR PID	.	.	.	.	Page 4-6
	DOWNLOAD PID SETPOINT	.	.	.	.	Page 4-7

PREFACE

This manual explains how to use the Horner APG PID Network Module which interfaces with the Reliance Shark PLCs. This manual describes the operation of the 45C-PIDNET when used in conjunction with the stand alone PID controllers .

ABOUT THE PROGRAMMING EXAMPLES

The example programs and program segments in this manual are included solely for illustrative purposes. Due to the many variables and requirements associated with any particular installation, Horner APG cannot assume responsibility or liability for actual use based on the examples and diagrams. It is the sole responsibility of the system designer utilizing the PID Network Module to appropriately design the end system, to appropriately integrate the PID Network Module and to make safety provisions for the end equipment as is usual and customary in industrial applications as defined in any codes or standards which apply.

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CHAPTER 1: INTRODUCTION

The PID Network Interface Module (NIM) allows for the seamless integration of stand-alone PID controllers with the Reliance Shark PLC. The module interfaces via RS-485 with up to 28 PID controllers. These controllers feature a wide variety of input and output configurations. The operation of these controllers is described in detail in the HE Stand Alone PID Controller User Manual. The "stand-alone" nature of these controllers allow many PID loops to be integrated with a single Shark PLC without significantly increasing the scan time of the PLC system. The controllers also can continue to operate normally whether or not the PLC is operational.

1.1 Manual Convention

In this manual, the Network Interface Module will be referred to as an NIM. The stand-alone PID controllers will be referenced as PIDs. These abbreviations will be made for both clarity and brevity of the instructions contained in this manual.

1.2 What You Have

The HE Network Interface Module (NIM) comes complete with the following items:

- A. Network Interface Module (NIM),
- B. Recipe Editor Software,
- C. This Manual.

1.3 What Else You Need

A complete HE PID Network also requires the following:

- A. An IBM compatible computer running DOS 2.0 or later with at least one serial (COM) port. The COM port must be interrupt based. Almost all personal computers utilize interrupt based serial ports.

- B. A Serial Cable to connect a personal computer to the NIM RS-232 serial port.
- C. One or more HE stand-alone PID Controllers (PIDs) and the associated user's manual.
- D. Shielded, twisted-pair wiring for connection between the NIM and the PIDs.

1.4 System Features

The HE Network Interface Module (NIM) features:

- o The ability to communicate with up to 28 HE stand-alone PID controllers via RS-485,
- o PID parameters set-up with personal computer software,
- o Stores up to 41 sets of PID parameters ("recipes"),
- o Stores up to 51 lists of controllers and recipes ("jobs") which can be downloaded automatically for easy production line changeover,
- o Updates the PLC with the latest process and control variable values for each controller.

1.5 Hardware Description

The HE Network Interface Module (NIM) features an 80C51 microprocessor running at 11.052 MHz. It incorporates two serial ports. The RS-232 port is used for setup purposes and operates at 9600 baud, no parity, eight data bits and one stop bit. The RS-485 port is used for network communications with the PID controllers (PIDs) and operates at 2400 baud, no parity, eight data bits, and one stop bit.

CHAPTER 2: INSTALLATION

2.1 Module Placement

The Horner Electric PID Network Interface Module (NIM) may be placed in any Reliance Shark PLC slot. Follow the instructions in your Reliance manual for module insertion and removal.

2.2 Terminal Wiring

The Network Interface Module features two (2) serial communications port. The RS-232 (programming) port has a DB-9, 9-pin female connector. The cable diagrams in Figure 2-1 can be used to construct a serial cable for communications between the port and a personal computer.

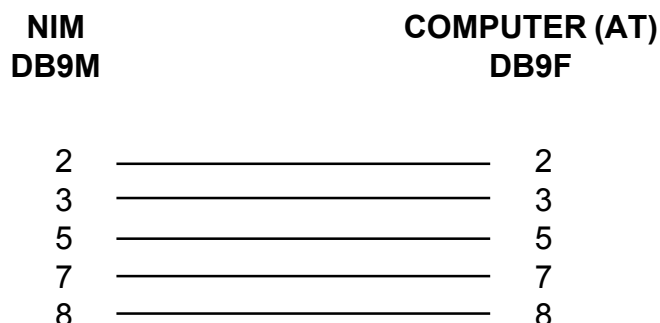


Figure 2-1

The RS-485 (network) port has a DB-15, 15-pin female connector. Only three wires are required for communications between the NIM and the PID controllers. The wiring diagram in Figure 2-2 illustrates proper cable construction for network communications. Note the terminating resistor that must be added to the terminal strip of the last PID controller on the daisy chained network

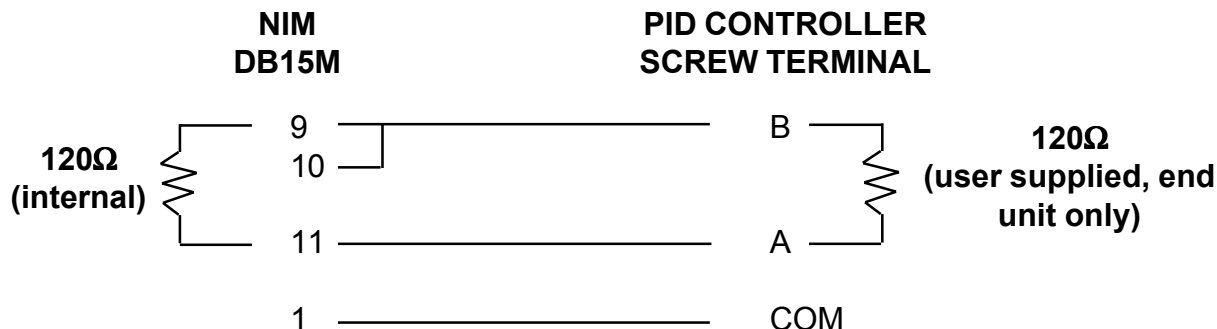


Figure 2-2

CHAPTER 3: THE RECIPE EDITOR SOFTWARE

The Network Interface Module (NIM) serves two purposes in the PID network. First, it provides an interface between the PID controllers (PIDs) and the Reliance Shark PLC. This interface allows the PLC to receive updates on the current status of control variables and process variables in individual PID controllers. Second, it stores within its memory PID parameter recipes and jobs. These can be downloaded to the PIDs upon command from the PLC.

The NIM operates under two “modes” of operation, Manual and Automatic. In **Automatic Mode**, the NIM receives its instructions from the PLC. This is the normal mode of operation after a PID network has been installed and is controlling the process. Before this can happen, recipes and jobs should be created and stored in the NIM. **Manual Mode**, discussed here, typically is the mode of operation during the setup of the NIM, when it receives its commands from the Recipe Editor software.

3.1 What is a “Recipe”?

A recipe is a complete set of PID parameters stored in the NIM which may be downloaded on demand to one or more PID controller(s). PID parameters stored in the recipe are described in detail in the *HE Stand-Alone PID Controllers User's Manual*, and include the following:

CONTROLLER TYPE
SETPOINT
GAIN OUTPUT
GAIN RATIO OUTPUT
PID RATE
PID RESET TIME
CYCLE TIME PID OUTPUT 1
CYCLE TIME PID OUTPUT 2*
RAMP-TO-SETPOINT TARGET TIME
LOWER SETPOINT LIMIT
UPPER SETPOINT LIMIT

* applies only to PIDs with two outputs.

Up to 41 different recipes can be stored in the NIM. Each recipe must have a unique number, between 0 and 40 inclusive. Each PID may use several different recipes. Also, one recipe may be shared by several different PIDs. The only restriction is that a recipe can only be shared by PIDs of identical type (i.e. same type of inputs and outputs). **Figure 3-1** shows a sample recipe as stored in the NIM.

Horner Electric PIDNET			
File	Recipe	Job #	Change Initialize
CONTROLLER		RECIPE	
ID#:	TYPE: 110	0	
PROCESS VARIABLE	 :		
SETPOINT	 : =		
GAIN OUTPUT (0 - 400)	 : =		
GAIN RATIO OUTPUT (0.0 - 2.0)	 : =		
RATE (0 - 900) seconds	 : =		
RESET (0 - 3600) seconds	 : =		
ALARM 1	 : =		
ALARM 2	 : XXXX		
CYCLE TIME OUTPUT 1 (0 - 120) seconds	 : =		
CYCLE TIME OUTPUT 2 (0 - 120) seconds	 : XXXX		
SETPOINT TARGET TIME (1 - 99) minutes	 : =		
LOWER SETPOINT LIMIT	 : =		
UPPER SETPOINT LIMIT	 : =		
STATUS: NOT CONNECTED COM PORT: 1 INIT MODE: MANUAL			

Figure 3-1

3.2 What is a “Job”?

In manufacturing operations, a single production line may produce many different products. The process of adjusting or modifying a production line to run a different product is often called “changeover”. When using PIDs on a production line, changing parameters or recipes is a common way in which the PIDs can be “changed over” to produce a different product.

A “job” is a list of PIDs with specified recipe numbers which are to be used in a given production line setup. When a production line changeover to a new job is instigated by the PLC, the NIM downloads new recipes to the PIDs based on the information stored in the job list. **Figure 3-2** shows a sample job as stored in the NIM.

If a production line produces many different products, a unique “job” may be stored for each product. If a production line produces only one product, it is likely that only one job will be used. Up to 51 different jobs, numbered 0 to 50, may be stored in the NIM.

3.3 PID Parameter Information Flow

Recipes and jobs are created and stored in the NIM with the Recipe Editor software package. This package runs on IBM compatible personal computers (see Chapter 2 for complete hardware requirements). This package allows users to set PID parameters, store them to disk, store them in the NIM, and download them from the NIM to the PIDs. An outline of the flow of information between the computer, NIM, and PIDs is shown in **Figure 3-3**.

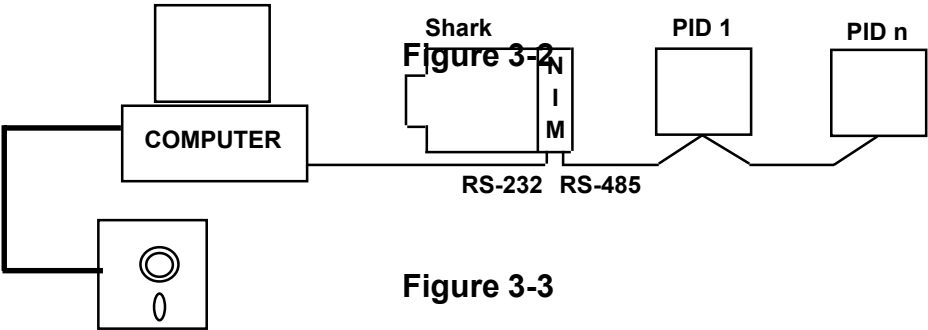
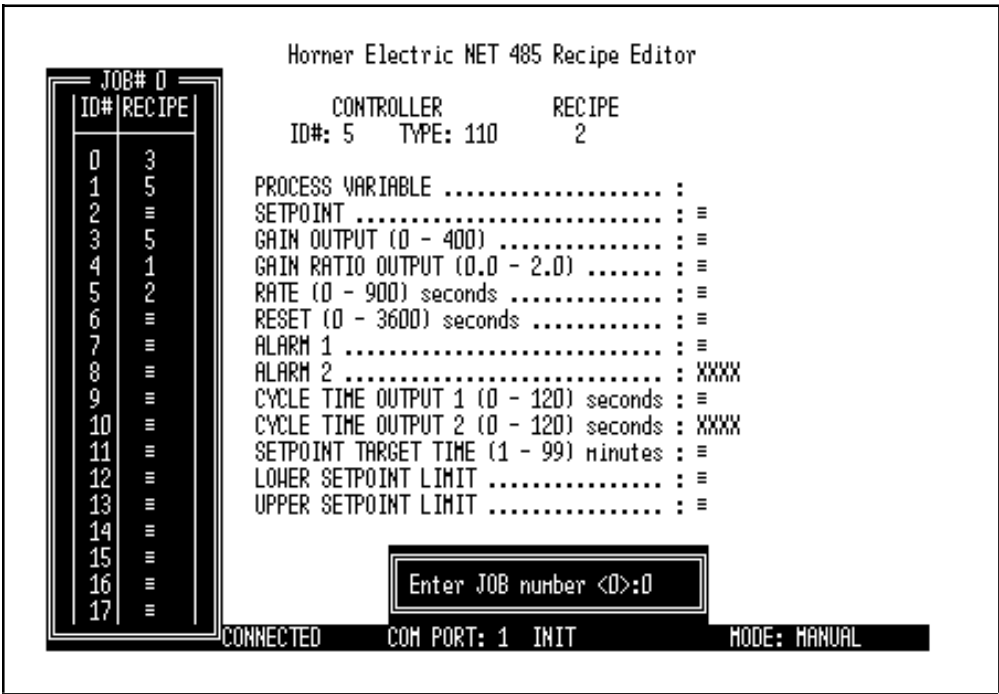


Figure 3-3

Recipe and job storage is restricted to personal computer magnetic disk until an RS-232 link is established between the personal computer and the NIM. At that point, recipes and jobs may be downloaded and stored to non-volatile RAM in the NIM. If PIDs are connected via RS-485 to the NIM, the NIM's stored recipes can then be transferred to the PIDs upon command from the personal computer. After system installation, the PLC initializes the transfer of recipes from the NIM to the PIDs.

3.4 Starting the Recipe Editor Software

Before running the Recipe Editor Software, you should make a working copy of the distribution diskette and put the distribution diskette in a safe place for future use. If utilizing a personal computer with a hard drive, it is best to create a subdirectory on your hard drive from which to run the software.

To start the software, type **PIDNET** from the DOS prompt. **Figure 3-1** shows the screen layout.

3.5 The Status Bar

The Status Bar is the portion of the screen where the Recipe Editor software displays the current status of the following items:

COM Port. The selected COM port on the computer is displayed, along with its “initialized” (INIT) or “not initialized” (NOT INIT) status. If the port is not initialized, it is likely that the port either does not exist or is inoperative. Another port should be selected.

Status. This shows the status of the NIM-computer RS-232 connection. The Recipe Editor software checks periodically to verify the connection. If there is a communications problem, a “not connected” status will be reported. If the connection is OK, a “connected” status will be reported.

Mode. While connected, the Recipe Editor software monitors the mode of the NIM, “Automatic” or “Manual”. If this mode is changed by the software, the status bar will indicate the change. If the mode is changed in the PLC configuration while the software is connected, the status bar will indicate this change as well. If the NIM is “not connected”, the software is unable to inquire as to the current NIM mode. In that case the status bar will always indicate a mode of “manual”.

3.6 Accessing Commands Using the Pull-Down Menus

The Recipe Editor software utilizes pull-down menus for easy operation. The available menus are accessed by pressing the **<Backspace>** key. The **<Right>** and **<Left>** arrow keys are used to move the cursor to select the desired menu. Once the desired menu is highlighted, the **<Up>** and **<Down>** arrow keys are used to move the cursor to the desired menu item. Pressing **<Enter>** activates the chosen menu item command. To exit from the pull-down menu system without making a selection, press the **<Escape>** key.

3.6.1 The File Menu

The File Menu offers commands relevant to starting a new session, retrieving and saving information to computer disk, and ending the session. The available commands are as follows:

New. Clears all the recipes and jobs currently resident in the IBM program's RAM memory. This command should only be used if the information has been previously stored to disk, or if it is to be discarded.

Load. Retrieves recipes and jobs from computer diskette to the IBM program's RAM memory. This information is stored in the program **PID.DAT**. In order to save more than one setup you should copy this file to a different file name. Then when you wish to retrieve this information simply copy your file to PID.DAT. The Recipe Editor software will load this file when the load command is chosen.

Save. Saves the current recipes and jobs residing in the IBM Program's RAM memory to computer diskette or the NIM memory. After selecting the Save item, the user is asked whether the information is to be saved to the NIM or to computer disk. In order to save to the NIM, the Connection Status must be "Connected".

Quit. This aborts operation of the Recipe Editor software and returns to DOS. This command should only be used if the information residing in the program's RAM memory has been previously stored to disk, or if it is to be discarded.

3.6.2 The Recipe Menu

The Recipe Menu allows new recipes to be created, existing recipes to be edited, viewed, and downloaded to the appropriate controller. Menu items include the following:

Copy. This command allows an existing recipe to be copied into another. This is useful when creating a new recipe which is virtually identical to another recipe (for instance, same except for different setpoint). After this item has been selected, the user is prompted for the recipe to copy from, and then the recipe number to copy to.

Edit. This command allows new or existing recipes to be edited. Once this item has been selected, pop-up windows prompt the user for the recipe number to be edited, and the controller input and output types. The cursor is then placed on the recipe parameter list, which the user may complete. While editing recipe parameters, the **<Up>** and **<Down>** arrow keys are used to navigate the cursor to the different parameters. Once highlighted, individual parameter values are filled-in simply by typing in the value followed by the **<Enter>** key. Editing the recipe is complete when the **<Escape>** key is pressed or when the **<Enter>** or **<Down>** arrow key is pressed while the cursor resides on the final parameter, "Upper Setpoint Limit".

Download. This command allows a recipe stored in the memory of the NIM to be downloaded to an individual PID controller. Note that the recipe **must** reside in the NIM before download to a PID controller. Therefore a recipe created with the Recipe Editor

software must be saved to the NIM prior to download to a PID controller. See **Save** under the *File Menu*.

View. The view command is used to view recipes already created by the Recipe Editor software. After selecting this item, a pop-up window will appear indicating the recipe number displayed. The **<Right>** and **<Left>** arrow keys are used to increment and decrement the recipe number as the recipes are perused. Pressing **<Escape>** exits recipe view mode.

3.6.3 The Job Number Menu

The Job Number Menu allows new jobs to be created, existing jobs to be edited, viewed, and downloaded to the appropriate controllers. Menu items include the following:

Copy. This command allows an existing job to be copied into another. This is useful when creating a new job which is virtually identical to another job. After this item has been selected, the user is prompted for the job to copy from, and then the job number to copy to.

Edit. This command allows new or existing jobs to be edited. Once this item has been selected, pop-up windows prompt the user for the job number to be edited. The cursor is then placed on the job list, which the user may edit. The job list consists of a list of PIDs, and the recipes which the PIDs will use for a particular production job. The PIDs may all run the same recipe, or they may each run different recipes. Setting the recipe for a particular PID is accomplished in two steps. First, use the **<Up>** and **<Down>** arrow keys to place the blinking cursor on the desired PID number. Then, use the **<Left>** and **<Right>** arrow keys to select the appropriate recipe number for that PID. When the correct recipe number is displayed for that PID, press **<Enter>**. Repeat the process until all the PIDs used for that job are assigned a recipe. Editing the job is complete when the **<Escape>** key is pressed.

Download. This command causes a job download to occur from the NIM to the appropriate PIDs. The NIM will download recipes to PIDs as mapped out by the selected job list. Note that the job **must** reside in the NIM before downloading to PIDs will occur. Therefore a job created with the Recipe Editor software must be saved to the NIM prior to download to the PIDs. See **Save** under the *File Menu*.

View. The view command is used to view jobs already created by the Recipe Editor software. After selecting this item, a pop-up window will appear indicating the job number displayed. The **<Right>** and **<Left>** arrow keys are used to increment and decrement the job number as the jobs are perused. Pressing **<Escape>** exits job view mode.

3.6.4 The Change Menu

Mode. The Mode function allows the user to put the NIM in “Automatic” or “Manual” mode. In “Manual” mode, the NIM receives all commands from the Recipe Editor software via the RS-232 connection to the personal computer. In “Automatic” mode, the NIM receives its commands from the PLC CPU outputs. In order to change the mode of the NIM, the NIM Status must be “Connected”.

Port. The Port function allows the user to select the personal computer COM port used in the NIM RS-232 connection. Upon selection of this menu item, a pop-up window appears, prompting the user for the desired port number. Only COM ports 1 thru 4 are legal values. Immediately upon receiving the desired port number, the Recipe Editor software attempts to initialize the port. If it is unable to initialize the port, the port is not valid for that computer and another COM port must be selected.

Status. The Status function when selected attempts to establish a connection between the computer’s COM port and the NIM module. If it is successful, the Status Bar will change to indicate the “Connected” status. If it is unsuccessful, the Status Bar will indicate a “Not Connected” status. A “Connected” status is required before many functions (such as saving recipes and jobs to the NIM memory) can be performed.

Monitor. This function is used to select color or monochrome mode. If a monochrome monitor is used, menu use is difficult when the program is setup in color mode.

CHAPTER 4: AUTOMATIC MODE

The previous chapter discussed the manner in which recipes and jobs are created and stored to the NIM with the Recipe Editor software. That process is largely conducted while the NIM is in Manual Mode, in which the NIM receives its commands from the Recipe Editor software. This chapter discusses the operation of the NIM in Automatic Mode, in which the NIM receives its commands from the PLC.

4.1 Commands Initiated by the PLC

After the recipes and jobs have been created and downloaded to the NIM, the PLC can take over the task of initiating commands to the NIM. The following commands can be initiated by the PLC:

Download Recipe to PID. This command, when issued by the PLC, causes a recipe stored in the NIM to be downloaded to a single PID.

Download Job. This command causes a job list stored in the NIM to be executed. Every PID on the job list will have a recipe downloaded to it as specified by the job list.

Monitor. This command causes the NIM to report to the PLC the current values of the Process Variable and Control Variable of a given PID.

Download New Setpoint. This command causes the PLC to download a new setpoint to be loaded into a particular PID.

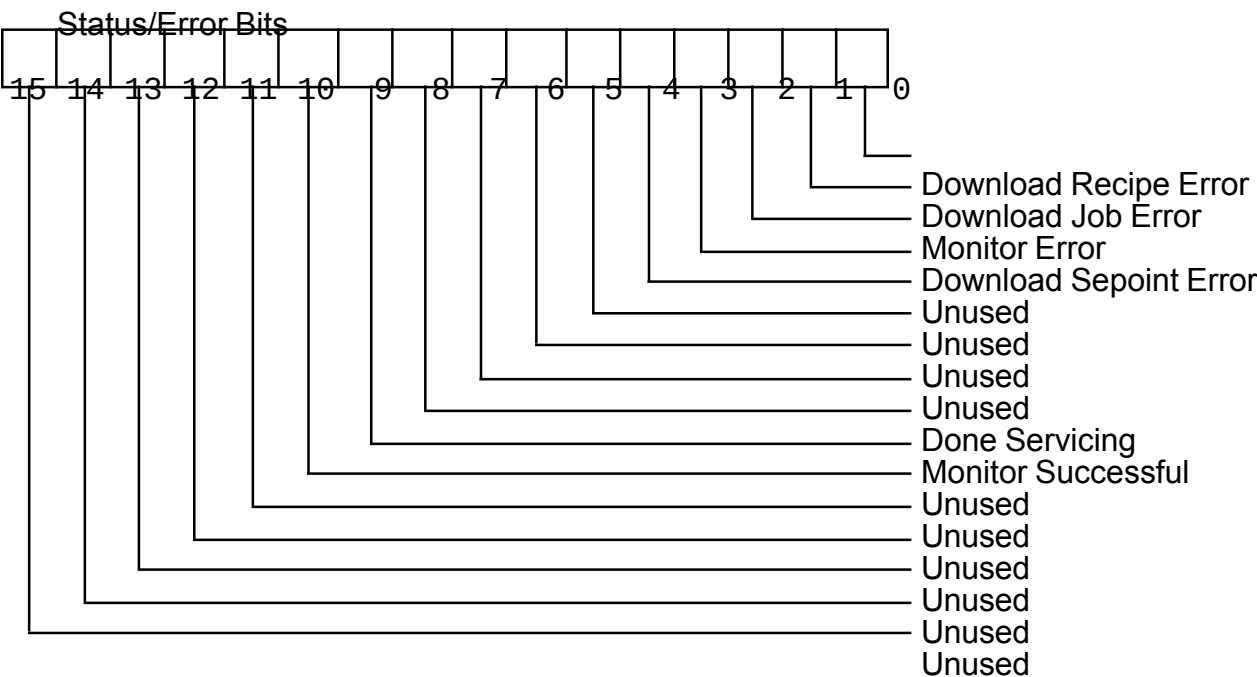
4.2 NIM I/O Reference Usage

The NIM utilizes seven SHARK I/O registers. These registers are "mapped" in the SHARK I/O "Slot" memory similar to the way analog modules are mapped. Their quantity and function is as follows:

I/O Type	Number	Function
Input Registers	3	Status/Error Bits and PID variables (PV & CV)
Output Registers	4	Command Bits and Command Parameters

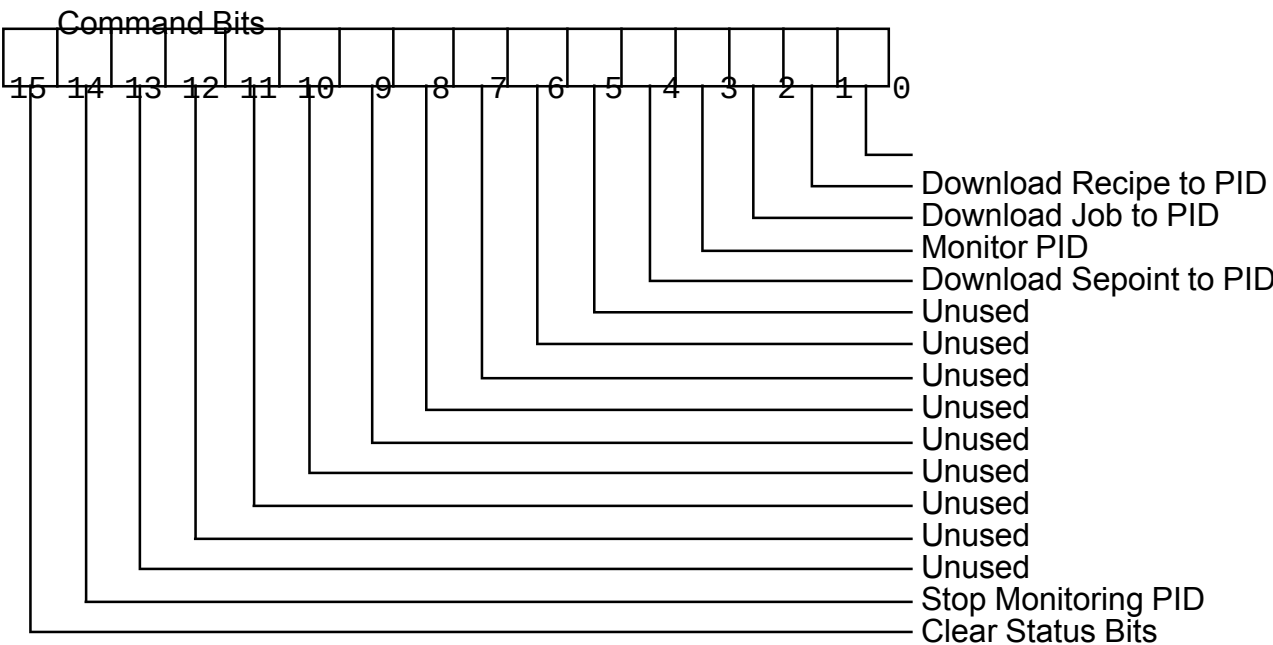
4.3 NIM I/O Reference Definitions**16 Bit Input Registers**

1	Status/Error Bits
2	Process Variable
3	Setpoint Variable



16 Bit Output Registers

- 1 Command Bits
- 2 Job Number
- 3 Recipe Number or Setpoint
- 4 PID Controller Number



4.4 Executing PLC Commands

Executing the commands described in Section 4.1 is accomplished by manipulating and monitoring the I/O References described in Section 4.2. This is performed in the PLC ladder logic. To perform the desired function (download job, download recipe, monitor PID parameters, change PID setpoint) the PLC ladder logic must manipulate the bits as described in the following pages.

RECIPE DOWNLOAD

Downloads a specific recipe to a specific PID.

To Start Recipe Download...

- 1) Load the recipe number into output register 3.
- 2) Load the PID number into output register 4.
- 3) Set bit (0) in output register 1 to a 1.

If Successful...

- 1) Error bit (0) in input register 1 will be 0.
- 2) Status bit (8) in input register 1 will be 1.
- 3) Clear bit (0) in output register 1 and Set bit (14) in output register 1 to a 1 to prepare for the next transaction.

If Unsuccessful...

- 1) Error bit (0) in input register 1 will be 1.
- 2) Status bit (8) in input register 1 will be 0.
- 3) Clear bit (0) in output register 1 and Set bit (15) in output register 1 to a 1 to prepare for the next transaction.

JOB DOWNLOAD.

Downloads a complete job to the PIDs.

To Start a Job Download...

- 1) Load the job number into output register 2.
- 2) Load the PID number into output register 4.
- 3) Set bit (1) in output register 1 to a 1.

If Successful...

- 1) Error bit (1) in input register 1 will be 0.
- 2) Status bit (8) in input register 1 will be 1.
- 3) Clear bit (1) in output register 1 and Set bit (14) in output register 1 to a 1 to prepare for the next transaction.

If Unsuccessful...

- 1) Error bit (1) in input register 1 will be 1.
- 2) Status bit (8) in input register 1 will be 0.
- 3) Clear bit (1) in output register 1 and Set bit (15) in output register 1 to a 1 to prepare for the next transaction.

The Change Menu allows the user to change the Mode (Manual or Auto), the selected personal computer COM port for the NIM RS-232 connection, and the Status of the connection between the personal computer and the NIM. The following items reside on the Change Menu:

MONITOR PID

Monitors a specified PID's Process Variable (PV) and Setpoint Variable (SV). Can be called at any time. Once it is initiated, the selected PID is constantly monitored and its PV and SV values are placed in input registers 2 and 3. If another command (such as download) is executed, monitoring will continue following the completion of that command. Monitoring is stopped when the "Stop Monitoring" bit is set.

To Start Monitoring a PID...

- 1) Load the PID number into output register 4.
- 2) Set bit (2) in output register 1 to a 1 to begin monitoring that PID.

If Successful...

- 1) Status bit (9) in input register 1 will be a 1.
- 2) Error bit (2) in input register 1 will be 0.
- 3) Input register 2 will contain PID's PV.
- 4) Input register 3 will contain PID's SV.
- 5) Set bit (13) in output register 1 to a 1 to stop monitoring.
- 6) Clear bit (13) and (2) in output register 1 to prepare for the next monitoring transaction.

If Unsuccessful...

- 1) Error bit (2) in input register 1 will be 1 and Status bit (9) in input register 1 will be a 0.

Either...

- 1) Continue monitoring until Status bit (9) in input register 1 is a 1 and error bit (2) in input register 1 is a 0.

Or...

- 1) Set bit (13) in output register 1 to a 1 to stop monitoring.
- 2) Clear bit (13) and bit (2) in input register 1 to prepare for the next monitoring transaction.

DOWNLOAD PID SETPOINT

Downloads a new setpoint to a PID controller's RAM memory. To load a new value to non-volatile memory, a Recipe or Job Download must be performed.

To Start a PID Setpoint Download...

- 1) Load the new setpoint value into output register 3.
- 2) Load the PID number into output register 4.
- 3) Set bit (3) in output register 1 to a 1.

If Successful...

- 1) Error bit (3) in input register 1 will be 0.
- 2) Status bit (8) in input register 1 will be 1.
- 3) Clear bit (3) in output register 1 and Set bit (14) in output register 1 to a 1 to prepare for the next transaction.

If Unsuccessful...

- 1) Error bit (3) in input register 1 will be 1
- 2) Status bit (8) in input register 1 will be 0.
- 3) Clear bit (3) in output register 1 and Set bit (15) in output register 1 to a 1 to prepare for the next transaction.